SWEET CLOVER

HARVESTING AND THRASHING THE SEED CROP

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SWEET CLOVER should be cut for seed when three-fourths of the seed pods have turned dark brown to black. At this time some flowers and many immature pods will be found on the plants, but the field will have a brownish cast.

Sweet-clover seed pods shatter badly when mature. For this reason every precaution should be taken to cut the plants at the proper stage and to save as much of the shattered seed as possible.

Shattering may be reduced to a minimum by cutting the plants when they are damp from rain or dew.

No machine thus far placed on the market has given entire satisfaction in cutting sweet clover for seed.

The ordinary mower should not be used for harvesting the seed crop.

The seed crop is usually cut with a self-rake reaper, grain binder, grain header, or corn harvester. The self-rake reaper and the grain binder have been most satisfactory.

The seed crop should be stacked unless it can be thrashed within two weeks after cutting.

Much shattered seed will be saved if a wagon with a tight floor is used for hauling the plants. If the wagon bed is not tight it should be covered with a tarpaulin or canvas.

The seed may be flailed from the plants, as is customary in the South, or it may be thrashed with a grain separator or clover huller, as is the practice in the North.

The ordinary grain separator may be adjusted so that it will hull 90 per cent of the seed.

Sweet-clover straw has considerable feeding value.

SWEET CLOVER: HARVESTING AND THRASHING THE SEED CROP.[1]

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THE CROP TO HARVEST FOR SEED.

White sweet clover and biennial yellow sweet clover are harvested for seed the year following seeding. In localities where these species will produce two cuttings the second year, either the first or the second crop may be harvested for seed. As the plants die when mature, only one cutting will be obtained if the first crop is permitted to ripen. It is becoming a general practice in many sections of the country to utilize the first crop of the second season for pasture, ensilage, or hay, and the second crop for seed. As a rule, this is the most profitable and economical way to handle sweet clover, as the first crop will produce an abundance of nutritious pasturage or from 6 to 10 tons of ensilage or 1 to 3 tons of hay to the acre. The second crop seldom grows more than 4 feet high when the first crop is pastured or cut. The shorter growth of the second crop is a very desirable feature, as it may be cut with a grain binder without difficulty. When the first crop of white sweet clover is permitted to mature, the plants often make so large a growth that it is very difficult to handle them with ordinary farm machinery. This trouble is experienced more often in humid regions than in semiarid sections.

As biennial yellow sweet clover seldom grows as tall as the white species, little difficulty is experienced in cutting the first crop of the second year for seed with a grain binder. Annual yellow sweet clover, or sour clover, is seldom grown for seed, as a sufficient quantity to supply the market is obtained from the screenings of wheat grown in the Southwest.

Sweet-clover seed ripens irregularly and shatters badly when mature. On this account much seed is lost before and during harvest, and ordinary harvesting machinery has not been entirely satisfactory for handling the crop.

[1] This bulletin discusses only the harvesting and thrashing of the sweet-clover seed crop. The growing of sweet clover and its utilization are discussed in Farmers' Bulletin 797, entitled "Sweet Clover: Growing the Crop," and Farmer's Bulletin 820, entitled "Sweet Clover: Utilization," respectively.

TIME TO CUT THE SEED CROP.

Opinions of extensive growers of sweet clover differ as to the proper stage at which to cut the seed crop. Some believe that it should be cut when the pods on the lower branches have turned dark brown to black, while others maintain that it is best to wait until the seed on the upper portions of the plants is mature. The time of cutting the seed crop should be governed largely by the machinery which is to be used. If the plants are to be harvested with a self-rake reaper or a grain binder, they should be cut when approximately three-fourths of the seed pods have turned dark brown to black. At this time some flowers and many immature pods will be found on the plants, but the field will have a brownish cast. If the crop is not cut until the seed pods on the uppermost branches have matured, most of the pods on the lower branches will have shattered.

It is the practice in regions where a grain header is employed to permit the plants to become somewhat more mature before cutting the seed crop than in sections where other machines are used. More seed is shattered when the plants are cut at the latter stage, but this is not necessarily a loss, as the grain header is employed for the most part in semiarid regions, where the shattered seed is depended upon to reseed the land.

LOSS OF SEED FROM SHATTERING.

From one-fifth to three-fourths of the total seed yield of sweet clover is lost from shattering. The percentage of the loss which occurs before harvesting will depend largely on the time the crop is cut. Much seed may be lost if harvesting is delayed for only a few days, and many fields have been observed in which at least 90 per cent of the seed had shattered in less than two weeks after the time the plants should have been cut.

The percentage of seed which is lost in harvesting will depend largely upon the manner of handling the crop. The binder or header may be equipped at a small cost, so that much of the seed which ordinarily is lost while cutting may be saved. Much shattered seed will be saved by using wagons with tight platforms or platforms covered with canvas. All unnecessary handling should be avoided.

Shattering may be reduced to a minimum by cutting the plants when they are damp from rain or dew. It is the practice in some regions to cut in the early morning or late evening, but this procedure will apply only to small acreages, since it is necessary to cut the crop as soon as possible when it reaches the proper stage for harvesting. It is a good practice to cut sweet clover at night, as the plants usually are damp at that time.

MACHINERY USED FOR HARVESTING THE SEED CROP.

No machine thus far manufactured has given entire satisfaction for cutting the sweet-clover seed crop. On account of the ease with which the pods shatter, it is a question whether any machine can be devised which will handle this crop without the loss of some seed. It is possible and practicable, however, for farmers at a small cost to equip their binders with pans and guards, so as to save most of the seed which otherwise would be lost.

THE ORDINARY MOWER.

The ordinary mowing machine is one of the most unsatisfactory devices used for harvesting this crop, as the subsequent handling necessary to place the plants in windrows or cocks causes much of the seed to shatter. The use of this machine for this purpose should be avoided whenever possible.

THE SELF-RAKE REAPER.

The self-rake reaper is one of the most efficient machines employed to cut sweet clover for seed. (Fig. 1.) This machine deposits the newly cut plants with the tops all turned one way in gavels or bunches at the side, so that the horses do not trample them on the next round. A high stubble also may be left, thereby reducing the weight and bulk of the plants which must be hauled to the thrashing machine.

It is the custom in some localities to leave the gavels to cure as dropped by the reaper on the ground, while in other sections they

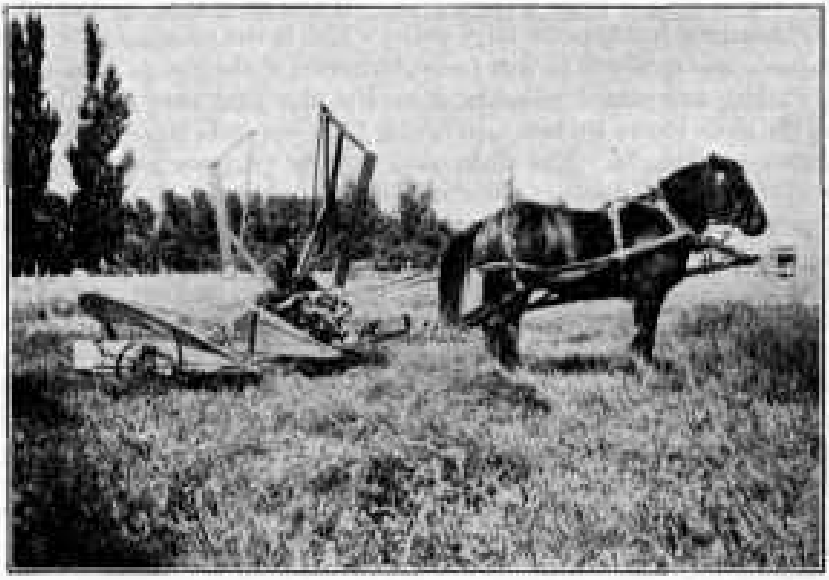

FIG. 1.—A self-rake reaper used in some sections of the country for cutting the sweet-clover seed crop.

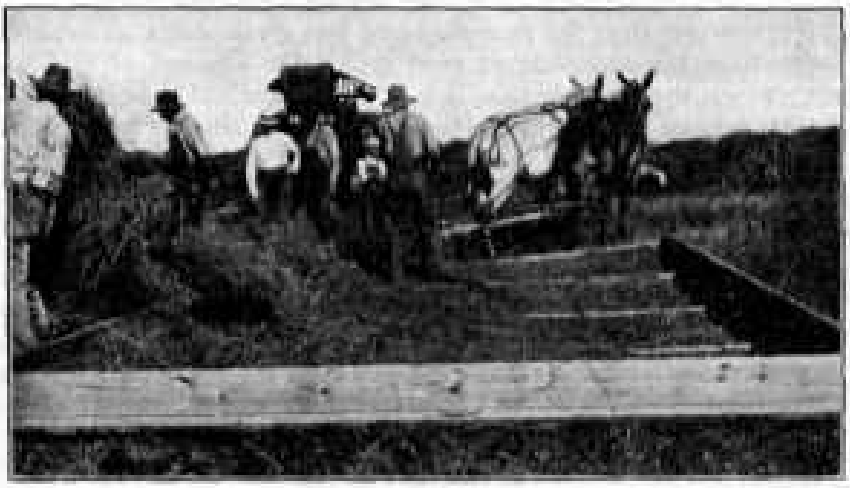

FIG. 2.—A sled used in western Kansas for hauling sweet clover from the field to the thrashing machine.

are placed in cocks that weigh about 300 pounds each when cured. If the gavels are to be placed in cocks, this should be done immediately after cutting, as the plants will be somewhat green and tough at this time and fewer pods will shatter than when the plants are permitted to dry before handling. When the crop is to be hauled to the thrashing machine on wagons it is best to permit the gavels to cure as dropped by the reaper, as it will then be possible to pitch them on the wagon with a large 4-tined fork. If the crop is to be hauled to the thrashing machine on large sleds, which is the practice in western Kansas, less seed will be lost from shattering if the gavels at the time of cutting are placed in cocks of such a size that they may be put on the sleds entire by two men lifting from opposite sides of the cock with 4-tined forks. The sleds used for this purpose usually are 12 by 20 feet in size, made of matched flooring and with 6 to 12 inch sides. (Fig. 2.) Matched or tight floors are necessary, so that all seed which shatters may be saved. These would not be so essential, however, if the sleds were covered with a tarpaulin or canvas. From the standpoint of saving shattered seed, this method of hauling the crop from the field to the thrashing machine is possibly the most economical thus far used. It is estimated that at times as much as one-third of the seed yield is collected from the floors of the sleds. It would be a good plan to replace the runners of the sleds with very low trucks, as this would lighten the draft considerably.

When sweet clover is cut with a self-rake reaper the crop is thrashed directly from the field. From 7 to 10 days of good haying weather is sufficient to cure the plants in the gavel or cock. Thrashing should be done as soon as possible, as much seed is shattered by rains and

winds. While a self-rake reaper is used to some extent in different sections of the country, it is used most extensively in the western North-Central States, and especially in western Kansas.

THE GRAIN BINDER.

A grain binder is employed extensively for cutting the sweet-clover seed crop. (Fig. 3.) The general use of this machine in many sections of the country is due to the fact that it is found on most farms and therefore causes no outlay of money, rather than because of its efficient work. It is not so efficient as the self-rake reaper unless it is equipped with pans and guards to save the seed which shatters.

It is possible to equip the grain binder with pans and extensions to the rear elevator plate and binder deck, so that at least 95 per cent of the seed which shatters when the crop is cut may be saved. These pans and extensions may be made out of ordinary galvanized metal and strap iron. The galvanized metal may be purchased at any tin shop or hardware store, and if sufficient strips of iron can not be found around the farm for this purpose strap iron may be purchased at any blacksmith shop. The material for these pans and extensions should not cost more than $4.50 or $5, and it should be possible to have them made complete for $8 or $10, including material. Unless there are a forge and drill on the farm it will be necessary to have the braces and supports for the pans made at a blacksmith shop. The strap iron used in connection with the pans may vary in size, but for

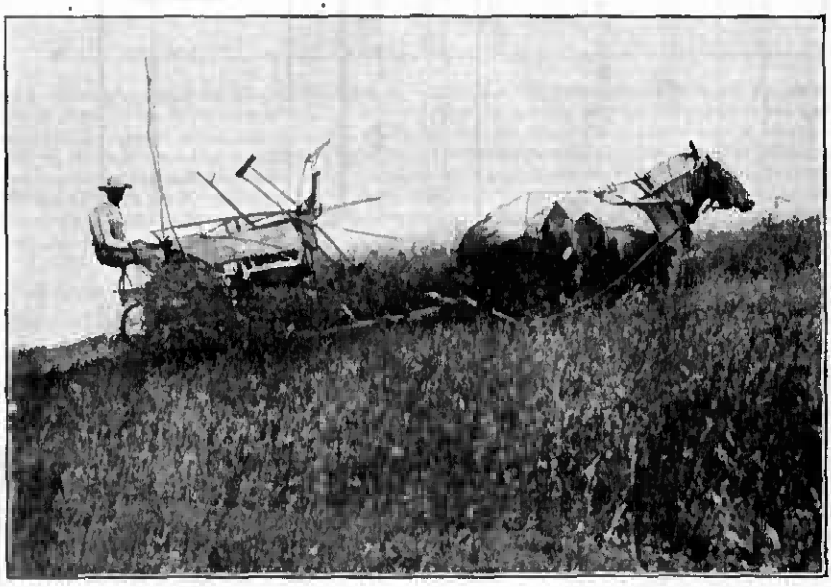

FIG. 3.—Cutting sweet clover for seed with a grain binder.

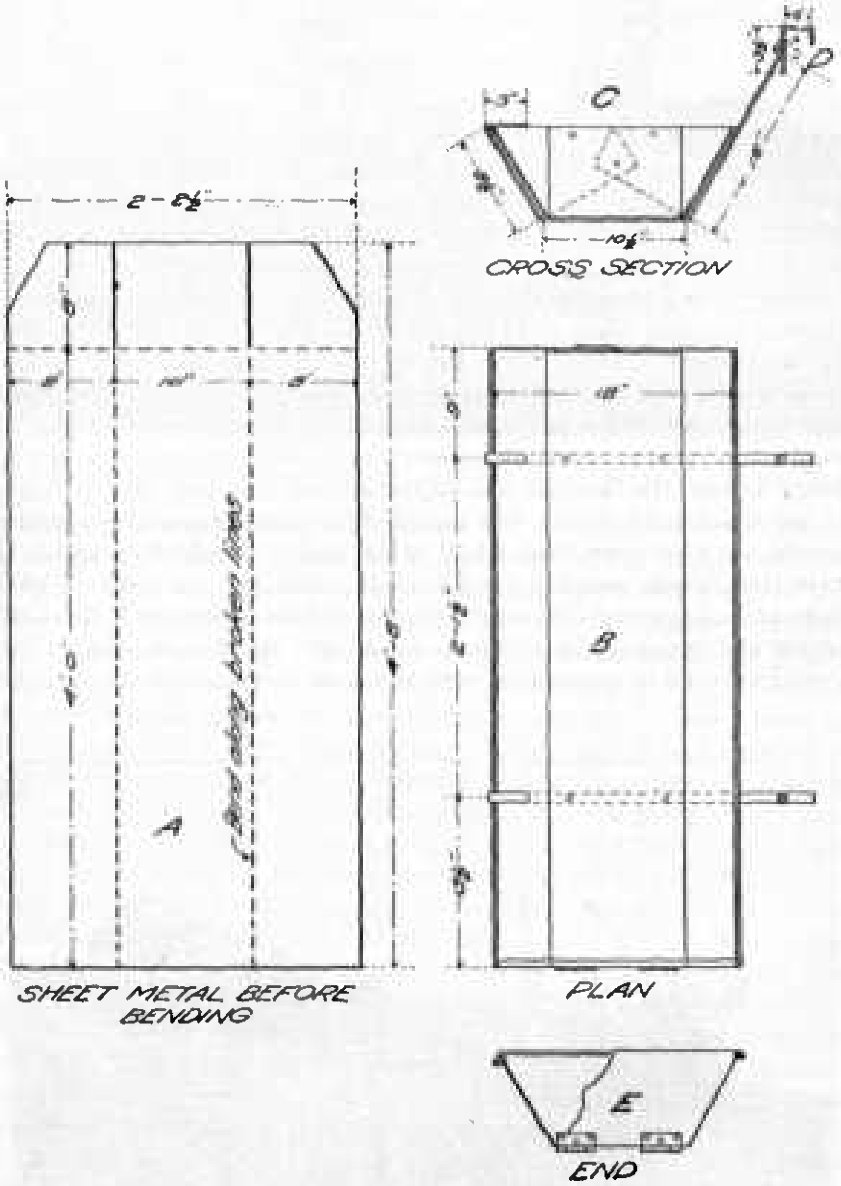

FIG. 4.—Plans for a pan to be placed under the opening between the platform and lower elevator of a grain binder in order to save the sweet-clover seed which falls on the platform and on the extension to the rear elevator plate. *A*, Size and shape of the metal before bending; *B*, general plan of the pan when completed, as viewed from the top; *C*, cross section of the pan and outline of the support which holds it in position; *D*, stirrup which hooks over the inside sill and to which the support is fastened; *E*, door.

the most part it need not be heavier than one-eighth inch in thickness and seven-eighths inch in width. The supports for the pan under the binder deck preferably should be one-quarter inch thick, as this pan will have much more strain on it than the pans under the elevators. Where bolts are to be used, ordinary stove bolts will suffice.

The plans for making the pan which should be placed under the opening between the platform and the lower elevator are illustrated in figure 4. The material to be used for this pan should be cut to conform to the size and shape shown in figure 4, *A;* the sides should then be bent upright along the dotted lines, so that the pan will be

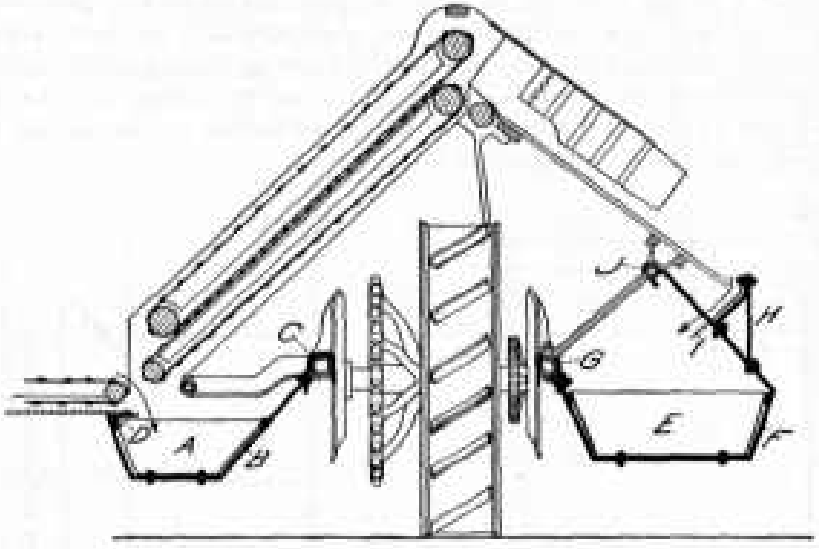

FIG. 5.—Rear view of a grain binder, showing a cross section of the pans and supports and the parts of the machine to which they are attached. *A*, Pan under the opening between the platform and lower elevator; *B*, support of the pan; *C*, stirrup which fits over the inside sill and to which the support is bolted; *D*, angle iron under the end of the platform and over which one end of the support is hooked; *E*, cross section of pan under the binder deck; *F*, support of the pan; *G*, stirrup which hooks over the outside sill and to which the support is bolted; *H*, angle iron which supports the guard at the end of the deck; *I*, guard which directs the seed that falls on the binder deck into the pan below; *J*, binder pipe over which one end of the support is hooked.

18 inches wide at the top. One end, which should be solid, may be made so by bending the center portion upright and then bending the sides against it. The side and center pieces should be riveted together. (Fig. 4, *C*.) Any suitable door which will prevent seed from falling out of the pan will suffice for the other end. A door is highly desirable, so that the seed may be removed more easily when the pan is full. A convenient type is shown in figure 4, *E*. A top view of the pan when completed is given in figure 4, *B*. It will be necessary to brace the pan, and this may be done by riveting strips of strap iron, preferably one-eighth inch thick and one-half inch wide, on the outer edges of the sides.

This pan is held in position by two supports made of strap iron, preferably seven-eighths inch wide and one-eighth inch thick, which have been bent to conform to the outside of a cross section of the pan. (Figs. 4, *C*, and 5, *B*.) The ends of these supports which fasten under the platform should be bent to a sharp angle and the tip of each slightly flattened, so that they may be pushed between the angle bar at the end of the platform and the bottom of the platform. The other end of each support should have a hole drilled in it, so that it may be bolted to the stirrups, which should be made to hook over the inside sill. (Figs. 4, *C*, and 5.) These supports should be placed about 6 inches from the ends of the pan and riveted or bolted to it. This will serve to brace the pan and to hold it in place. The pan may be attached to the machine by hooking the supports over the angle iron on the bottom of the platform and by bolting them to the stirrups on the sill. By supporting the pan in this manner it may be easily and quickly attached or removed.

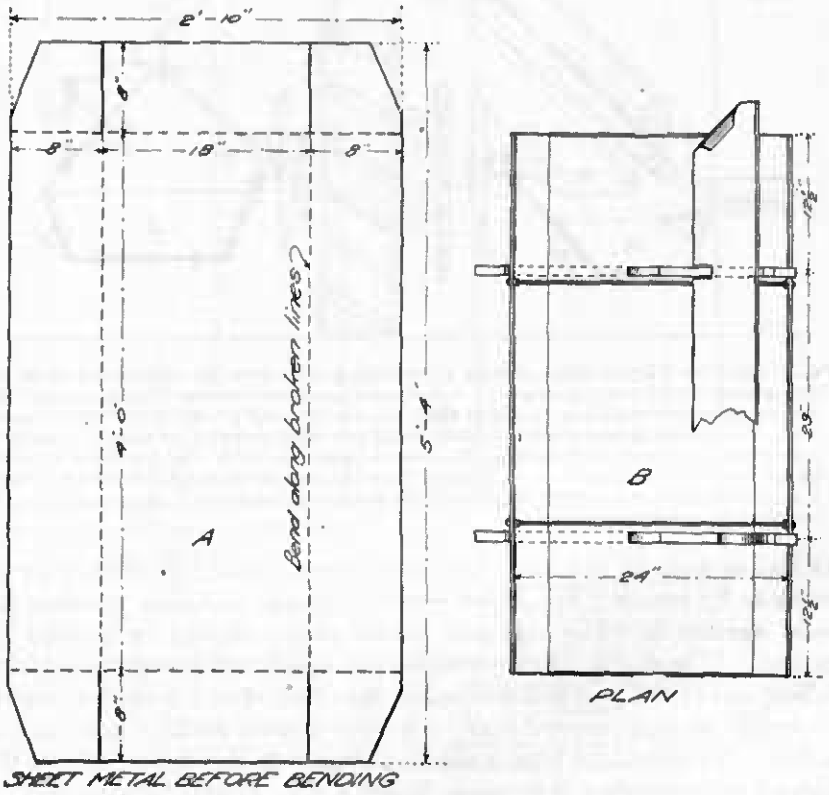

FIG. 6.—Plans for the pan to be placed under the binder deck of the grain binder. *A*, Size and shape the metal should be cut before bending; *B*, general plan of the pan when completed, as viewed from the top.

The pan to be placed under the deck of the machine will serve to collect the seed which is shattered on the deck and the extension to the deck. The plans for making this pan are shown in detail in figure 6. The material should be cut along the solid lines and of the size designated in figure 6, *A*. The sides of the pan should be bent upward on the dotted lines, so that the pan will be 24 inches wide at the top. The ends should then be made in the manner described for the pan which is placed under the opening of the platform and lower elevator. A door may be put in the rear end of this pan if desired; but this is not necessary, as no trouble will be experienced in removing the seed. Figure 6, *B*, gives a top view of the pan when completed and also a portion of the guard which serves to direct into this pan the seed which shatters on the deck. This guard is shown in detail in figure 7. As this pan is larger and heavier than that placed under the lower elevator, not only should it have strips of iron riveted to the outer edges of the sides, but two cross braces also should be employed. These may be fastened to the strips of iron supporting the sides of the pan and should be about 12 inches from the ends of it. This pan is supported by two strips of strap iron bent to conform

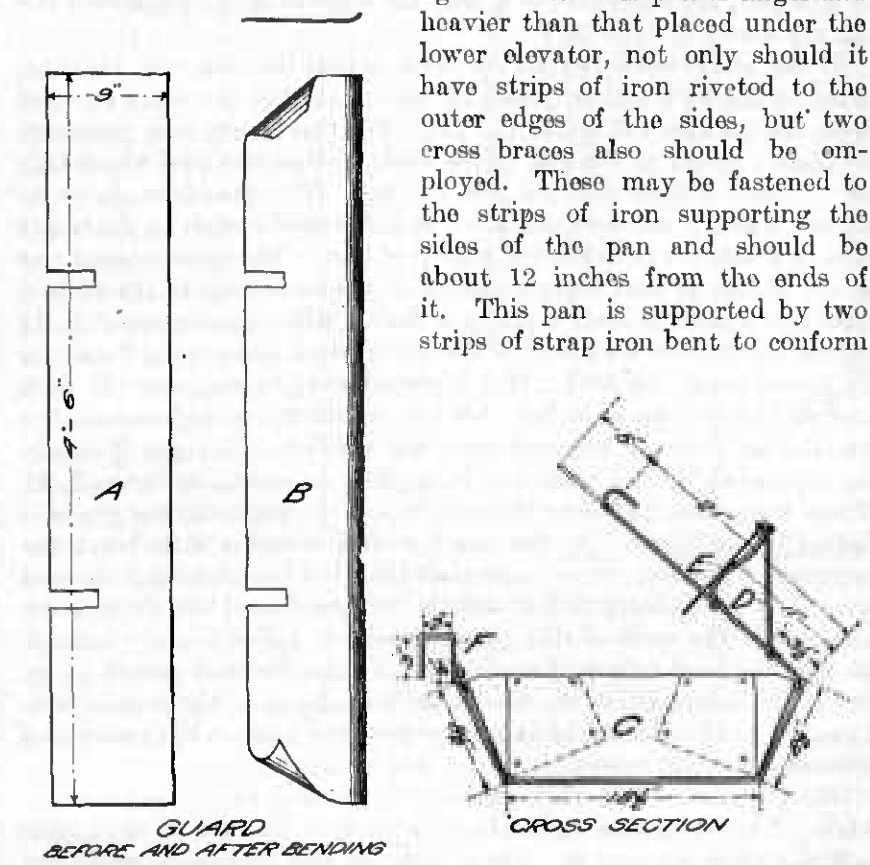

FIG. 7.—Plans for the guard to be placed at the end of the binder deck of the grain binder and cross section of the pan and supports illustrated in figure 6. *A*, Size and shape of the metal for the guard; *B*, shape of the guard when completed; *C*, cross section of the pan and support to which this guard is attached; *D*, angle iron which supports the guard at the end of the deck; *E*, guard bolted in position; *F*, stirrup which hooks over the outside sill and to which the support is bolted.

to the outside of a cross section of it and hook over the binder pipe under the deck and bolt to stirrups placed on the outer sill of the frame. Each support may be made from one strip of strap iron. It may be necessary to bend the ends of the supports which hook over the binder pipe in opposite directions. Both ends of the supports which hook over the binder pipe may hook outward, as shown in figure 7, *C*, or the rear support may hook inward, as illustrated in figure 5. It is not absolutely necessary that these supports of the pan hook in opposite directions on the binder pipe, yet when this is done it will make the pan more rigid. The pan may be attached by first hooking the supports over the binder pipe underneath the deck and then bolting the other end of the supports to the stirrups on the outer sill. The pan should be fastened to the supports. A cross section of this pan, the supports for it, and the stirrups which hook over the sill are shown in figure 7, *C*.

If this pan extends beyond the deck so that the seed which is shattered on the deck will drop directly into it, the bundles when released from the packers will strike the pan. For this reason it is necessary to place a guard at the end of the deck, so that the seed which falls on the deck will be directed into the pan. This guard, as shown in figures 5 and 7, consists of a piece of galvanized metal, to the upper side of which has been riveted a strip of iron. The upper side of this guard should be bent slightly inward at the lower edge of the strip of iron and placed in such a position that it will be approximately 1½ inches beyond the lower end of the binder deck and extend from 1 to 1½ inches above the deck. If it is placed at right angles to the deck and no higher than 1½ inches above it, it will not interfere with the bundles as they are released from the packers. This guard should be supported by two angles of strap iron, as shown in figure 7, *D*. These braces are bolted to the supports of the pan, and the guard is bolted to the braces. As this guard should extend a little below the supports of the pan, so as to prevent the wind from blowing the seed over it, it is necessary to cut slots in the guard so it will fit over the supports. The ends of this guard should be rolled slightly inward, so that the seed falling close to them will be directed into the pan. When the extension to the binder deck is placed in the proper position, the seed collected by it will be directed against the guard and then into the pan below.

The extension to the elevator should be bolted to the rear elevator plate. This extension should be so wide that the tops of the plants will not reach beyond it. The details for this extension are shown in figure 8. The outer edge and lower end of this extension should be bent upward and slightly inward, so that the seed which falls upon it will be directed to the opening between the platform and lower elevator, where it will fall into the pan beneath. The curved edge of

the lower part of this extension should be flattened as much as possible, so that it will not interfere with the upper portions of the plants as they pass from the platform to the elevators. The opening must be sufficiently large, however, to permit small branches and racemes which fall upon the extension to pass into the pan. The angle of the lower portion of it must be large enough to permit the seed to run directly into the pan below. If this portion is sloped from the seat pipe to the opening between the platform and the lower elevator no trouble will be experienced. This extension may be bolted to the machine by drilling holes in it to coincide with those in the elevator plate.

It is necessary to widen the binder deck, so as to save the seed which is shattered from those portions of the plants which extend beyond it. This may be done by bolting to the rear end of this deck an extension, as shown in detail in figure 9. This extension may be made from one piece of galvanized iron, which should be cut along the solid lines and of the size shown in figure 9, *A*. It should be bent upward and slightly inward at the dotted lines shown in this figure. The extended strips, as shown in figure 9, *B*, should be riveted to the main part of the extension. When this is done a trough will be formed along the side and lower end of it, so that all seed which shatters upon it will be directed into the pan below the deck. The object in riveting the extended strips at the end of the extension to the main part is to prevent the tops of the plants from catching in the trough when the bundles leave the packers. It may be necessary to fasten a brace to the bottom of the deck to support this extension. This can be done, however, by using a strip of strap iron or wood. The upper end of this extension should be bent

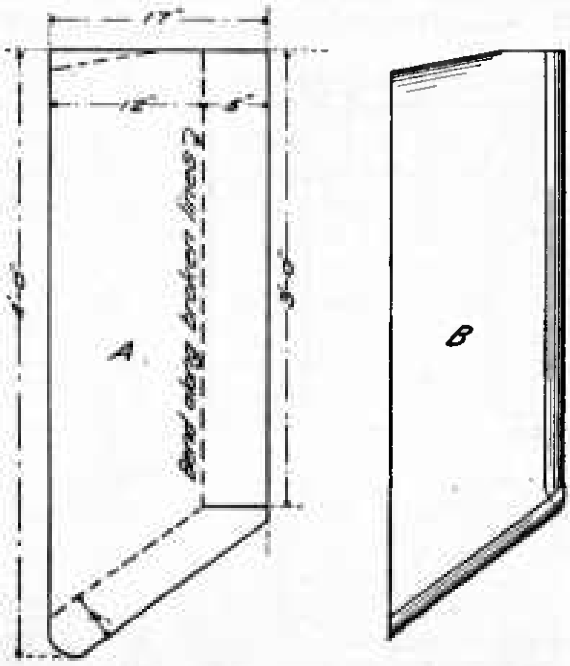

FIG. 8.—Plan of the extension which is bolted to the rear elevator plate of the grain binder. *A*, Size and shape of the metal to be used for this extension; *B*, extension when completed.

to fit under the upper end of the one attached to the elevator plate, so that the plants will not be hindered in passing from one to the other. Both extensions may be braced strongly at the top by fastening them to a right angle of iron or wood.

A grain binder equipped with the pans and extensions herein outlined is shown in figure 10.

Binders equipped in the manner described have been tested carefully in different sections and have proved beyond doubt that they offer an economical device for harvesting sweet clover for seed. This equipment has been used most extensively in Livingston County, Ill., where farmers have saved with it from $6 to $10 worth of seed per acre. When this equipment is used the plants may be permitted to become somewhat more mature before cutting, as the seed which is shattered will be saved by the pans.

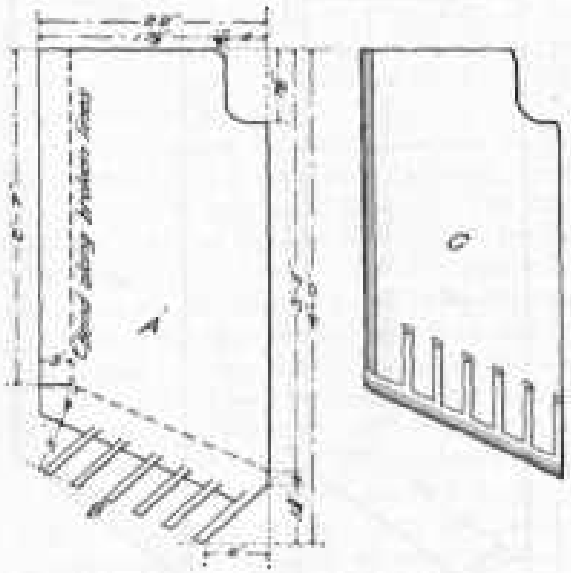

FIG. 9.—Extension to the binder deck of the grain binder. *A*, size and shape of the metal before bending; *B*, extended points which are to be bolted to the main portion of the metal; *C*, extension when completed.

As the pans and extensions described have been designed for one type of binder, it may be necessary to modify them slightly for use on other types of machines. Before making a set of these pans and extensions for any machine, the plans shown should be compared carefully with the binder to be equipped, in order that any changes which will need to be made may be noted. The pans and extensions at least may be made on the farm, and then it will be an easy matter to check up the measurements for the supports, which may be made at a blacksmith shop.

Difficulty may be experienced in cutting sweet clover with a binder when the first crop has been permitted to mature, as the plants may be so tall that the machine will not handle them properly. This difficulty may be overcome entirely in most sections of the country by pasturing the field until the first part of June or by cutting the first crop for hay. It is recommended that the stubble be left as high as possible when cutting sweet clover for seed. Not only will this greatly facilitate harvesting but it will leave many of the

woody, unpalatable portions of the plants on the ground, where they will decay quickly and help to increase the humus content of the soil. (See the illustration on the title-page.)

When the seed crop is cut with a binder it is best to shock the bundles as soon as possible, so as to avoid unnecessary shattering. Conditions should determine whether the bundles be placed in long narrow shocks or in round shocks. The plants will cure somewhat faster in long narrow shocks, and this form should be preferred when grasshoppers are not troublesome. Sweet-clover shocks should not be capped, as capping will cause some seed pods to shatter.

THE GRAIN HEADER.

Grain headers have been used successfully for harvesting the sweet-clover seed crop in several sections of the United States, especially in western Kansas. The principal advantages in using this machine are that a larger acreage may be cut in a given time than with either a grain binder or a self-rake reaper and that a high stubble may be left. The greater acreage which may be cut with a header is important when large acreages are to be harvested, as much seed is lost by shattering if the crop is not cut at the proper stage for harvesting, while the high stubble which may be left when cutting the seed crop with a grain header is a decided advantage, as it not only reduces greatly the weight and bulk of the plants which must be thrashed, but it also leaves the hard, woody portions on the ground, where

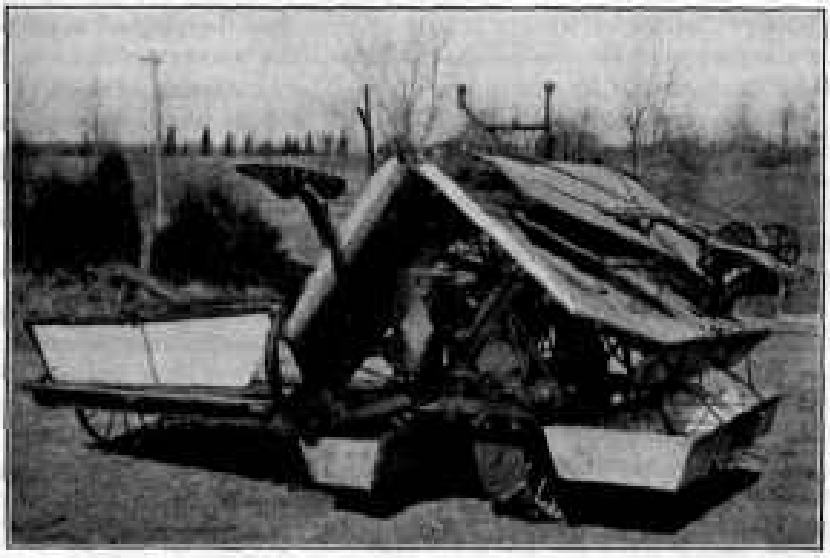

FIG. 10.—A grain binder equipped with pans and extensions to the rear elevator plate and binder deck to save the sweet-clover seed which is shattered while cutting the crop.

they will decay and be of some value as a fertilizer. It is best to remove only those portions of the plants which contain sufficient seed to thrash, but this is not always possible, even with a header, unless the field contains a fairly thin stand and the plants are not more than 4½ to 5 feet high. When the seed crop is to be cut with a grain header, it usually is permitted to stand somewhat longer than when other machines are used.

A tin pan or some other receptacle should be placed at the lower end of the header elevator in order to save the seed which otherwise would be lost at that place.

The plants are carried into header wagons or barges in the same way as grain. When a heavy crop is cut it will be necessary to have two men in the barge to handle the plants. The floor of the header wagon should be made perfectly tight, or it should be covered with a canvas or tarpaulin, so as to save the seed pods which shatter.

When the crop is cut at the proper stage it may be placed directly in stacks or ricks without danger of heating or molding, provided the ricks are covered or topped with some material which will shed water and are built upon a foundation, so that air may circulate under them. Native grass or green sweet-clover plants of the first year's crop will serve very nicely for topping the stacks.

It is the custom of some people to place the barge loads close together in individual stacks so located that they may be hauled quickly and easily to the thrashing machine. On other farms enough barge loads are placed together to make a rick approximately 10 by 10 by 40 feet in size. When each barge load is placed in a separate stack it is necessary to load the plants again, so as to haul them to the thrashing machine. The shattering of seed pods and the extra labor caused by reloading and by hauling the plants may be avoided for the most part by placing the crop in ricks large enough for a day's thrashing. It is good practice to place such ricks in pairs sufficiently close together for both to be pitched directly to the feeder of the machine. When this method is employed two days' thrashing may be done without moving the machine.

The header binder, consisting of an attachment placed upon the header to bind the cut plants, has been used successfully in cutting the sweet-clover seed crop.

THE CORN HARVESTER.

Corn harvesters are proving to be efficient machines for cutting sweet clover which has made a growth too large to be cut with a grain binder. Even when the field has been seeded broadcast a 3-foot swath may be cut with the corn harvester, provided the gathering or divider points are extended to collect the plants. This may be done by fastening to each point a piece of wood or iron about

18 inches long. When a corn binder is used no more seed is lost from shattering than when an ordinary grain harvester is employed, unless the latter is equipped with special pans and extensions, for the reason, primarily, that the portions of the plants which produce

FIG. 11.—Cutting sweet clover for seed with a corn harvester. This field had been seeded in 30-inch rows.

most of the seed extend above the gathering or divider boards and are not crushed. When a 5-foot or larger growth is cut with a corn binder, the plants are tied below the seed-bearing branches.

In the semiarid sections of the country a limited quantity of sweet clover is planted in rows for both forage and seed production. In such a case the seed may be harvested with a corn binder. (Fig. 11.)

STACKING THE SWEET-CLOVER SEED CROP.

Much discussion has taken place among extensive growers of sweet clover as to the advisability of stacking the seed crop after it is cut with a grain binder or a corn harvester. The conditions present in each case should determine the proper course to pursue. If it will be impossible to thrash within 10 days after cutting, much less seed will be lost by stacking two or three days after cutting than by permitting the plants to remain in the field subject to possible rains. In such cases it is urged that the crop be stacked, as the seed saved by this operation, if the handling is done with care, will much more than pay for the labor. When it is possible to thrash in a week or 10 days after cutting, the crop should be thrashed directly from the field, as little seed ordinarily will be lost during this time and the work of stacking will be avoided.

When the crop is to be stacked, the stacks should be built in the same way as stacks of grain; and when properly built they will shed water as well as grain stacks. (Fig. 12.) It is well, however, to provide a covering, and if canvas is not available a top-dressing of green grass or young sweet-clover plants will suffice. Sweet clover should remain in the stack for three or four weeks, as it will require about that time for the plants to pass through the sweat. A stack should always be placed on high ground, where water will not collect about the base, and it is recommended that a foundation of some kind be provided, so that air may circulate beneath. A few posts or rails will answer this purpose very well.

FIG. 12.—A stack of sweet clover.

THRASHING THE SWEET-CLOVER SEED CROP.

Two methods are in general use for thrashing the sweet-clover seed crop. The seed may be flailed from the plants, or it may be removed by a grain separator or a clover huller.

FLAILING THE SEED.

Much of the sweet-clover seed harvested in the South is flailed from the plants. This method is necessarily slow and does not hull the seed. It is practicable, therefore, only in regions where the necessary machinery for hulling the seed crop is not available or where the acreage to be thrashed is very limited. One advantage of thrashing the seed in this manner is that the straw is left in the field, where it will add much organic matter to the soil.

When the seed is to be flailed, the crop ordinarily is cut with a scythe or mowing machine and the plants raked into piles or windrows. If only small areas are to be harvested in this manner, a canvas or tarpaulin may be spread on the ground beside a windrow or pile and several forkfuls of sweet clover pitched on the canvas, where the seed may be removed from the plants by striking them a few

times with flails, sticks, or forks. After the plants have been struck a few times they should be turned over and struck again. When the seed is removed from the plants, the straw may be pitched to one side, the canvas placed beside another portion of the windrow or by another pile, and the operation repeated. It is not necessary to remove the seed from the canvas until its weight or bulk interferes with moving the canvas.

It is the practice in some sections of the country to place a well-braced frame, covered with wire netting, on a sled and to flail the seed on this frame. The netting used for covering the frame should have meshes 1 inch or less in diameter. The sled should be at least 7 feet wide and 10 feet long and should have sides and ends approximately 12 inches high. Smaller sleds sometimes are used, but a larger one is to be preferred if two or more persons are to flail on it at one time. If the floor of the sled is not perfectly tight, it should be covered with canvas and the edges of the canvas thrown over the sides and ends of the sled, so as to avoid losing any of the seed and to facilitate its removal. A sled so equipped may be drawn from pile to pile, the plants pitched on it, the seed flailed from them, and the straw returned to the land for soil improvement.

Another method, very similar to that just described, is to place a frame on a hayrack. The frame should be built sufficiently strong and in such a manner that the person who is to do the flailing may stand on it. It should be covered preferably with galvanized-wire netting having half-inch meshes, and if this is stretched tightly it will serve to strengthen the frame. If it is not practicable to make the hayrack perfectly tight, it should be covered with a tarpaulin or canvas. A wagon so equipped may be pulled from pile to pile or along the windrows, where one person may pitch the plants upon the frame, to be flailed by one or more persons standing on it. After the seed is removed from the plants, the straw may be scattered easily and quickly over the ground for soil improvement.

Flailed seed should be cleaned thoroughly with sieves and fanning mills to remove the inert matter and immature pods before it is sown or offered for sale on the market. It is recommended that whenever possible unhulled seed be run through a clover huller to hull the seed or through an Ames hulling and scarifying machine to remove the hulls and to scarify the seed. By this process the outer coat of the seed is scratched or broken. The scarifying increases the percentage of germination by facilitating the entrance of moisture.

THE GRAIN SEPARATOR.

A grain separator (fig. 13) is used more than any other machine for thrashing sweet clover. This is because more grain separators than clover hullers are found in localities where sweet clover is

grown and because the ordinary clover huller will not handle a large growth of sweet clover satisfactorily. When the grain separator is operated carefully no trouble should be experienced in removing the seed from the plants, but it is necessary to make certain adjustments if the seed is to be hulled. The adjustments required will vary somewhat with the make of machine and the dryness of the crop. The riddles should be adjusted or changed so they will handle sweet-clover seed properly. Alfalfa or red-clover riddles will answer this purpose. The speed of the fan should be decreased, so the seed will not be blown over, and this usually will be accomplished when the speed is reduced to about one-half that used in thrashing grain. The number of rows of concave teeth which should be used will vary with the dryness of the plants and somewhat with their size. When it is not desired to hull the seed, one or two rows of concave teeth will be sufficient. Some operators believe that one or two rows are sufficient to hull 40 to 50 per cent of the seed when the plants are very dry. These are exceptional cases, and hulled seed should not be expected unless more rows of concave teeth are used. If hulled seed is desired it is recommended that a full set be used and that these be set to run closer to the cylinder teeth than is customary when thrashing grain. Some operators replace two rows of the smooth, concave teeth with corrugated teeth. This practice is recommended wherever possible, as the corrugated teeth will facilitate greatly the hulling of the seed. Even when these changes are made, only a small percentage of the seed will be hulled if the pods are damp. If the plants have been permitted to make a very large

FIG. 13.—Thrashing sweet clover with a grain separator. Note the large sleds used for hauling the plants from the field to the thrashing machine.

growth the machine may clog unless the number of rows of concave teeth is reduced. Clogging may be overcome for the most part by feeding the bundles to the machine slowly. This precaution is necessary regardless of the size of the plants if the seed is to be removed properly and hulled. It is possible to hull from 90 to 95 per cent of the seed when the proper adjustments are made and the plants are dry.

A clover-hulling attachment, which consists for the most part of special sieves and a number of rows of corrugated concave teeth which replace the ordinary concave teeth, has been used with success in different sections of the country.

THE CLOVER HULLER.

As a rule, ordinary clover hullers do not handle sweet clover very satisfactorily. Machines with cylinders larger than those commonly used are giving fair satisfaction provided the plants do not make a large growth, but even these machines have not been so successful as properly adjusted and equipped grain separators. A clover huller will handle a 2 to 3 foot growth of sweet clover if the rows of thrashing concaves are reduced and the plants are fed slowly to the machine. It will not hull sweet clover as well as red clover, and it is very doubtful whether it will hull more seed than a grain separator equipped with a hulling attachment.

The manufacturer of at least one clover huller has designed special rasps for the hulling cylinder and concaves of his machine, and these rasps do better work than the ones ordinarily used for hulling red clover.

It is the custom in some localities to run the sweet clover through a thrashing machine without adjusting the concaves and then to run the unhulled seed as delivered by the grain separator through a clover huller. A fair quality of seed may be obtained by this process, but it calls for much extra labor and time, and for this reason should be avoided whenever possible.

YIELDS OF SWEET-CLOVER SEED.

Many factors besides shattering influence the yield of sweet-clover seed. As only those portions of the plants exposed directly to the sunlight set seed abundantly, thin stands usually produce more seed to the acre than heavy stands. When very heavy stands make a large growth, seed is produced only on the upper 24 to 30 inches of the plants, whereas with thinner stands it is produced on the lower branches as well.

The quantity of moisture in the soil at the time the seed is maturing is an important factor also. During hot, dry weather the plants may not be able to absorb from the soil sufficient water to supply the

excess required by them for seed production. In this event many of the seed pods will abort and fall when partly mature. Pods abort and fall in a very short time, so that partly shriveled ones seldom are found on the plants, although the extent of the aborting is shown by the number of barren racemes. When such weather conditions prevail, the second crop usually will produce a heavier yield than the first crop. This is due for the most part to the inability of the large plants to obtain sufficient water for seed production. The much smaller plants of the second crop do not require as much moisture as the larger plants of the first crop, as the vegetative growth is seldom more than half as much.

The type of root growth has much to do with the quantity of water the plants are able to obtain during droughty weather. When sweet clover is planted on soil that has a tendency to be wet, the plants will produce a much-branched shallow root system instead of the normal deep roots which are found on well-drained soils. During dry weather the upper layers of soil become so depleted that plants having a very large percentage of their roots in these layers can not obtain a sufficient quantity of moisture to supply their requirements for seed production.

It is often stated that the first crop of sweet clover will produce more seed to the acre than the second crop. This depends very largely upon the thickness of the stand and on weather conditions. In regions where two crops may be grown in a season, the first usually will produce more seed to the acre than the second if the field has a thin stand. When the stand is thick the second crop ordinarily yields more seed. In regions where a crop of hay or pasturage may be obtained in addition to the seed crop, it is seldom an economical procedure to permit the first crop to mature. Not only will sweet clover produce an abundance of nutritious pasturage or a cutting of 1 to 3 tons of hay in addition to the seed, but the difficulty of handling the large, stemmy growth of the first crop for seed is avoided.

Yields of sweet-clover seed have been reduced during the last two seasons by several fungous diseases. Experimental work has not been completed to show the percentage of damage done by these organisms, but in some sections of the country seed yields were reduced considerably. The clover stem borer,[1] which is prevalent in red clover in certain sections of the country, also infests sweet clover. It is probable that this insect did some damage to the seed crop in certain sections of the country in 1916.

The yield of sweet-clover seed varies from 2 to 10 bushels of recleaned seed per acre.

[1] *Languria mozardi.*

SWEET-CLOVER STRAW.

Sweet-clover straw may be utilized for soil improvement or as a roughage for stock. When it is not needed for feeding it should be turned under, as it will add much humus and nitrogen to the soil. When the seed is flailed from the plants the straw may be easily and quickly spread over the land at the time of flailing, but when the crop is thrashed with a grain separator or a clover huller it will be necessary to haul the straw and scatter it over the field. When the crop is thrashed in this manner the straw will be broken and crushed so that stock will eat it freely. The straw may be run directly from the thrashing machine into the silo, where, by adding sufficient water, it can be made into good silage. Table I gives the analyses of nine samples of sweet-clover straw which were collected in Illinois in the fall of 1916.

TABLE I.—*Analyses of sweet-clover straw.*[1]

Sample.	Moisture.	Ash.	Ether extract.	Protein.	Crude fiber.	Nitrogen-free extract.
No. 1	4.2	3.18	1.20	8.31	49.37	33.74
No. 2	4.7	3.40	1.03	5.88	53.65	31.34
No. 3	5.34	3.62	.89	6.14	51.11	32.9
No. 4	5.55	4.14	1.54	8.44	43.00	37.33
No. 5	4.75	2.94	1.28	6.81	51.42	32.8
No. 6	4.23	2.58	1.13	5.44	55.41	31.21
No. 7	5.53	3.66	1.52	7.19	46.34	35.76
No. 8	4.65	2.98	1.38	7.09	51.56	32.34
No. 9	4.92	4.22	1.70	8.44	46.11	34.61

[1] These analyses were made by the Bureau of Chemistry.